(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 795 900 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
24.03.2021 Bulletin 2021/12

(21) Application number: **18919158.8**

(22) Date of filing: **13.06.2018**

(51) Int Cl.:
F23D 14/08 *(2006.01)* ***F23D 14/46*** *(2006.01)*
F23D 14/84 *(2006.01)* ***F23D 14/64*** *(2006.01)*

(86) International application number:
PCT/CN2018/091102

(87) International publication number:
WO 2019/218414 (21.11.2019 Gazette 2019/47)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **15.05.2018 CN 201810462349**

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(54) COMBUSTOR AND WATER HEATER USING SAME

(57) A combustor and a water heater using the same. The combustor (10) comprises a plurality of flame distributors (100) which are arranged side by side in the width direction, each flame distributor (100) comprises at least three ejection tubes (110), and each ejection tube (110) is sequentially provided with an ejection section (110A) and an gas outlet section (110B) along the gas flow direction. Each ejection tube (110) comprises a throat (114) and a diverter (112). The throat (114) is provided at the minimum cross-section of the ejection section (110A), the length of the ejection section (110A) is H1, and the maximum width of the throat (114) allowing gas to pass is D1, wherein 8.5D1≤H1≤9.5D1. The diverter (112) is provided in the gas outlet section (110B) and has a top corner (112C) for diverting gas to two sides, and the angle of the top corner (112C) is 45 degrees to 85 degrees.

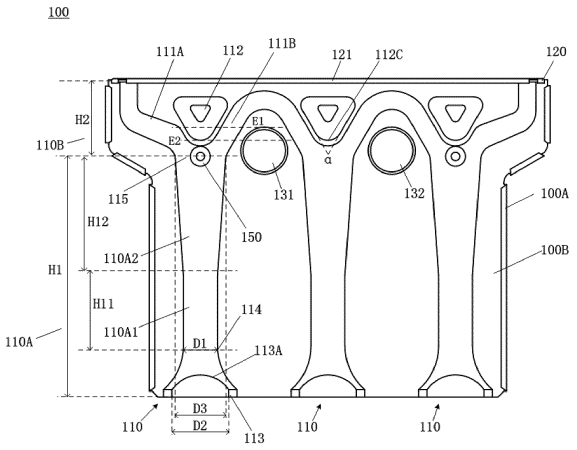

FIG. 2

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Description

CROSS-REFERENCE TO RELATED APPLICATION

[0001] The present application claims priority to Chinese Patent application, No. 201810462349.5, entitled "Combustor and Water Heater Using Same", filed with the Chinese Patent Office on May 15, 2018, which is hereby incorporated by reference in its entirety.

TECHNICAL FIELD

[0002] The invention relates to a field of combustor technology, in particular to, a combustor and a water heater using the same.

BACKGROUND

[0003] A water heater or a wall-mounted furnace is household equipment which takes fuel gas as a main energy source and provides domestic hot water or household heating. A combustor is an important component of a gas water heater and a wall-mounted furnace, and is a general term for devices that cause fuel and air to be injected in a certain manner and then mixed for combustion. Combustors are classified into industrial combustors, burners, civil combustors, and special combustors according to types and application fields.

SUMMARY

[0004] In order to solve technical problems of low combustion efficiency of a combustor and a large number of nitrogen oxides generated after combustion in the existing technology, the present invention provides a combustor and a water heater using the same.

[0005] As an aspect of embodiments of the present invention, in an embodiment of the present invention, it is provided a combustor, which includes a plurality of flame distributors, the plurality of flame distributors are distributed side by side along a width direction, a flame distributor includes at least three ejection tubes, an ejection tube is provided with an ejection section and a gas outlet section in a sequence according to a gas flow direction, and the ejection tube includes:

a throat, provided at a minimum cross-section of the ejection section, wherein a length of the ejection section is H1, and a maximum width of the throat allowing gas to pass through is D1, wherein $8.5D1 \leq H1 \leq 9.5D1$; and
a diverter, provided in the gas outlet section, having an apex corner for diverting gas towards two sides, the angle of the apex corner being 45 degrees to 85 degrees.

[0006] Further, the ejection section includes:

a premixing section, the ejection tube has a uniform cross-sectional shape in the premixing section, a length of the premixing section is H11, wherein $2D1 \leq H11 \leq 3D1$; and
a diffusion section, gradually deviating from a central axis of the ejection tube along a gas flow direction, a length of the diffusion section is H12, wherein $3.5D1 \leq H12 \leq 4.5D1$.

[0007] Further, the ejection section has an inlet end and an outlet end, a maximum width of the inlet end being greater than or equal to a maximum width of the outlet end, and the maximum width of the inlet end being greater than or equal to 18mm.

[0008] Further, the inlet end has an arc-shaped cross-section, the arc-shaped cross-section being formed by recessing a center of the inlet end towards the outlet end.

[0009] Further, $11mm \leq D1 \leq 14mm$.

[0010] Further, a length of the gas outlet section is less than or equal to 30%H1.

[0011] Further, the combustor further includes a gas distribution device provided below each of the ejection tubes, a plurality of gas passages being provided in the gas distribution device, the gas distribution device further including a plurality of nozzles through which the gas distribution device being communicated with the ejection tubes, the nozzle having a diameter D0, wherein D1=2D0.

[0012] Further, the flame distributor includes a first housing and a second housing that are symmetrically arranged, a gas channel of the ejection tube being formed by an enclosure of the first housing and the second housing; the diverter includes a first recess and a second recess that are symmetrically arranged, the first recess being formed by the first housing being recessed into a cavity of the ejection tube, the second recess being formed by the second housing being

recessed into a cavity of the ejection tube, a gas channel being defined between the first recess and the second recess; the flame distributor further includes a top plate covering a top of the ejection tube, the top plate being provided with a plurality of fire holes; and the first housing is snap-fitted with the second housing, and the top plate is snap-fitted with the first housing and the second housing.

[0013] Further, the diverter further includes at least two through holes, the through holes being provided between two adjacent ejection tubes, for allowing a cooling water pipe to pass through and being in close contact with the cooling water pipe.

[0014] As another aspect of embodiments of the present invention, in an embodiment of the present invention, it is also provided a water heater, which includes the combustor as described above.

[0015] By applying above technical scheme according to embodiments of the present invention, the ejection coefficient may be improved, and a generation of nitrogen oxides may be reduced.

[0016] The foregoing summary is merely for the purpose of illustration, and is not intended to be limiting in any way. In addition to the illustrative aspects, embodiments, and features described above, further aspects, embodiments, and features of the present invention will be readily understood from the following detailed description in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017]

FIG. 1 is a top view of a combustor according to an embodiment of the present invention.
FIG. 2 is a front view of a flame distributor of a combustor according to an embodiment of the present invention.
FIG. 3 is a left-side view of two flame distributors of a combustor according to an embodiment of the present invention.
FIG. 4 is a front view of a combustor according to an embodiment of the present invention.
FIG. 5 is an explosive view of a combustor according to an embodiment of the present invention.

Description of Numerical References:

10: combustor;	100: flame distributor;	
100A: first housing;	100B: second housing;	110: ejection tube;
111A: first flow guide inclined plane;	111B: second flow guide inclined plane;	112: diverter;
112A: first recess;	112B: second recess;	112C: apex corner;
110A: ejection section;	110B: gas outlet section;	113: inlet end;
113A: arc-shaped cross-section;	114: throat;	115: outlet end;
120: top plate;	121: fire hole;	131: water inlet pipe through hole
132: water outlet pipe through hole;	150: pitch positioning structure;	
151: first protrusion;	152: second protrusion;	160: igniter;
101: first flame distributor;	102: second flame distributor;	
103, 104: two adjacent flame distributors;		
171: first pressing plate;	172: second pressing plate;	180: connecting piece;
191: first fastener;	192: second fastener;	200: cooling water pipe;
210: water inlet pipe;	220: water outlet pipe;	
300: gas distribution device;	310: nozzle;	320: valve connection.

DETAILED DESCRIPTION

[0018] In the following, only certain exemplary embodiments are briefly described. As will be appreciated by those skilled in the art, the described embodiments may be modified in various ways without departing from the spirit or scope of the present invention. Accordingly, the drawings and description are to be regarded as illustrative in nature rather than restrictive.

[0019] In the description of the present invention, it is to be understood that orientations or positional relationships indicated by terms "center", "longitudinal", "transverse", "length", "width", "thickness", "upper", "lower", "front", "rear", "left", "right", "vertical", "horizontal", "top", "bottom", "inner", "outer", "clockwise", "anticlockwise", "axial", "radial", "circumferential" and the like are based on the orientations or positional relationships shown in the drawings, which are

merely for ease of description of the present invention and simplicity of description, and are not intended to indicate or imply that the device or assembly referred to must have a particular orientation, or be constructed and operated in a particular orientation. It is therefore not to be construed as limiting the present invention.

[0020] Furthermore, the terms "first" and "second" are used for descriptive purposes only and are not to be construed as indicating or implying relative importance or implicitly indicating the number of technical features indicated. Therefore, features defined with "first" and "second" may explicitly or implicitly include one or more such features. In the description of the present invention, "a plurality of" means two or more, unless specifically defined otherwise.

[0021] In the present invention, unless expressly stated and defined otherwise, the terms "mounted", "coupled", "connected", "fixed", and the like are to be construed broadly, for example, either as fixed or detachable connections, or as integrated connection; it may be a mechanical connection, an electrical connection, or a communication; it may be a direct connection, or an indirect connection through an intermediary, or two components may be interconnected inside or in an interactive relationship with each other. Specific meaning of the above terms in the present invention may be understood by those ordinary skilled in the art, as the case may be.

[0022] In the present invention, unless expressly stated and defined otherwise, reference to a first feature as being "above" or "below" a second feature may include reference to the first and second features being in direct contact, and reference to the first and second features not being in direct contact but being in contact by additional features therebetween. Furthermore, the first feature being "above", "over" and "on" the second feature includes the first feature being directly above and obliquely above the second feature, or merely indicates that the first feature has a higher horizontal height than the second feature. The first feature being "below", "underneath" and "under" the second feature includes the first feature being directly above and obliquely above the second feature, or merely indicates that the first feature has a lower horizontal height than the second feature.

[0023] The following disclosure provides many different embodiments or examples for implementing different structures of the present invention. To simplify the disclosure of the present invention, components and arrangements of specific examples are described below. They are, of course, merely exemplary and are not intended to limit the present invention. In addition, in the present invention numerical references and/or reference letters may be repeated in various examples for purposes of simplicity and clarity, which does not inherently indicate a relationship between the various implementations and/or arrangements discussed.

[0024] As shown in FIG. 1, which is a top view of a combustor 10 of the present embodiment, the combustor 10 of the present embodiment includes a plurality of flame distributors 100 distributed side by side along a width direction of the flame distributor 100, and a cooling water pipe 200 passing through the plurality of flame distributors 100, the cooling water pipe 200 is a U-shaped pipe including a water inlet pipe 210 and a water outlet pipe 220, to inlet and discharge water on a same side of the combustor 10, preferably, the cooling water pipe 200 is integrally formed.

[0025] As shown in FIG. 2, which is a front view of one of the flame distributors 100, the flame distributor 100 of the present embodiment includes three ejection tubes 110 and two through holes (a water inlet pipe through hole 131 and a water outlet pipe through hole 132), where two ends of the cooling water pipe 200 pass through corresponding through holes, respectively, i.e., the water inlet pipe through hole 131 is used for allowing the water inlet pipe 210 to pass through and be in close contact with the water inlet pipe 210, and the water outlet pipe through hole 132 is used for allowing the water outlet pipe 220 to pass through and be in close contact with the outlet pipe 220.

[0026] As shown in FIG. 3, which is a left-side view of two adjacent flame distributors 103 and 104, with reference to FIG. 1 and FIG. 2, in the present embodiment the flame distributor 100 may be formed by a first housing 100A snap-fitted with a second housing 100B, i.e., a gas channel of the ejection tube 100 is formed by an enclosure of first housing 100A and the second housing 100B, the water inlet pipe through hole 131 and the water outlet pipe through hole 132 pass through the first housing 100A and the second housing 100B. The flame distributor 100 further includes a top plate 120 which covers above the three ejection tubes 110 and is provided with a plurality of fire holes 121.

[0027] Referring to FIG. 2 and FIG. 3, each of the ejection tubes 110 is provided with an ejection section 110A and a gas outlet section 110B in a sequence according to a gas flow direction, where the ejection section 110A has an inlet end 113, a throat 114, and an outlet end 115, the ejection tube 110 ejects gas vertically upward from the inlet end 113, after the gas passes through the throat 114 and the outlet section 110B, and is then discharged from the fire hole 121, it is ignited by an igniter 160 to form a flame. In order to prevent the flame from being too strong due to an excessive force for ejecting the gas flow, end surfaces of the gas outlet section 110B of the ejection tube 110 are inclined to both sides, to form a flow guide inclined plane (including a first flow guide inclined plane 111A inclined to the left and a second flow guide inclined plane 111B inclined to the right).

[0028] A throat 114 is provided at a minimum cross-section of the ejection section 110A, i.e., gas passes through the throat 114 with the smallest passage area. A maximum width of the throat 114 allowing gas to pass through is D1, for example, when the cross-sectional shape of the throat 114 is circular, the maximum width D1 is the diameter of the throat 114; when the cross-sectional shape of the throat 114 is rectangular, the maximum width D1 is the longest diagonal of the throat 114.

[0029] Decreasing the maximum width D1 of the throat 114 may reduce the size of the flame distributor 100, and

increasing the length HI of the ejection section 110A and the maximum width D1 of the throat 114 may reduce the energy loss coefficient, thereby increasing the ejection coefficient and making the mixing of gas and air more uniform. Experimental results show that when H1=6D1, the energy loss coefficient of combustor ejection is about 2.2; when HI = 8D1, the energy loss coefficient of combustor ejection is about 1.8; when 8.5D1≤H1≤9.5D1, the energy loss coefficient of the combustor ejection is about 1.5. As reducing the energy loss coefficient is conducive to increasing the ejection coefficient, when the ejection coefficient increases, the volume of actual combustion products will increase, leading to a sharp decrease in the combustion temperature, which may in turn reduce a thermodynamic oxidation reaction, so that an emission of nitrogen oxides is reduced (the thermodynamic oxidation reaction refers to an oxidation reaction of nitrogen and oxygen in the air at high temperature, to generate nitrogen oxides, experiments show that as the reaction temperature increases, the oxidation reaction rate increases exponentially).

[0030] Preferably, the ejection section 110A includes a premixing section 110A1 and a diffusion section 110A2, the ejection tube 110 has the uniform cross-sectional shape in the premixing section 110A1, a length of the premixing section 110A1 is H11, where 2D1≤H11≤3D1; the diffusion section 110A2 deviates gradually from a central axis of the ejection tube 110 along a gas flow direction, and a length of the diffusion section 110A2 is H12, where 3.5D1≤H12≤4.5D1.

[0031] Further, a length H2 of the gas outlet section 110B is as such, H2≤30%H1, to reduce the size of the flame distributor 100.

[0032] Preferably, 11mm≤D1≤14mm, and the cross-sectional area of the gas channel formed by each flame distributor 100 at the throat 114 is $33mm^2 \sim 42mm^2$, therefore, increasing the number of ejection tubes facilitates reducing the maximum width of the throat 114, to reduce the size of the flame distributor 100. It should be noted that in the present embodiment, the number of the ejection tubes 110 may be three or more than three, and an increase of the number of the ejection tubes 110 may increase the ejection coefficient, thereby increasing the amount of ejected gas.

[0033] Further, a maximum width D2 of the inlet end 113 is greater than or equal to a maximum width D3 of the outlet end 115, preferably, D2=D3, and the center of the inlet end 113 is concave towards the outlet end 115, to form an arc-shaped section 113A, as shown in FIG. 2, the inlet end 113 with this large-round-corner design may make the gas flow smoother and increase the amount of air ejected through the gas, preferably, D2≥18mm.

[0034] As shown in FIG. 2 and FIG. 3, the ejection tube 110 further has a diverter 112, which includes a first recess 112A formed by recessing the first housing 100A into a cavity of the ejection tube 110, and a second recess 112B formed by recessing the second housing 100B into a cavity of the ejection tube 110. The diverter 112 is used for diverting gas, that is, a part of gas is influenced by the resistance of the diverter 112 to be diverted to two sides of the ejection tube 110, ejected from fire holes 121 corresponding to the two sides of the ejection tube 110, and burned to form a flame; while the other part of gas flows vertically upward from the gas channel between the first recess 112A and the second recess 112B, ejected from fire holes 121 corresponding to the center of the ejection tube 110, and then burned to form a flame.

[0035] The angle α of an apex corner 112C of the diverter 112 is preferably 45 degrees to 85 degrees, that is, the diverting angle of the apex corner 112C for diverting the gas towards both sides thereof is preferably 45° to 85°, to reduce the resistance of gas flow.

[0036] FIG. 4 and FIG. 5 show a front view and an explosive view of the combustor 10, respectively, that is, a view when a plurality of flame distributors 100 are combined together, in this embodiment, the combustor 10 further includes a gas distribution device 300 provided below each of the ejection tubes 110, a gas passage is provided in the gas distribution device 300, and is communicated with the ejection tubes 110 through a plurality of nozzles 310. In the operation of the combustor 10, a gas valve connected to a valve connection 320 is opened, gas enters the ejection tube 110 through the nozzle 310, and the diameter D0 of the nozzle 310 is smaller than the maximum width D1 of the throat 114, preferably, D1=2D0, so that more gas is ejected into the ejection tube 110, to increase the ejection coefficient and reduce the generation of nitrogen oxides.

[0037] Preferably, in the present embodiment, the water inlet pipe through hole 131 and the water outlet pipe through hole 132 are located between two adjacent ejection tubes 110, respectively, tops of the water inlet pipe through hole 131 and the water outlet pipe through hole 132 are preferably arranged at the same horizontal plane, the top E1 of the water inlet pipe through hole 131 should be higher than the bottom E2 of the diverter 112, so that the position of the cooling water pipe 200 is close to the top plate 120, thereby improving the cooling efficiency and reducing the generation of nitrogen oxides.

[0038] In the present embodiment, the combustor 10 is of a vertical structure, the direction of a gas flow is vertical after gas is ejected from the nozzle 310, and gas and air are mixed in the ejection tube 110 and then ignited at the fire hole 121, the large-round-corner inlet end 113 may eject more gas and reduce the diameter of the throat 114, on the premise of reducing the size of the flame distributor 100, increasing the length of the ejection section 110A allows for more uniform gas mixing. The design of at least three ejection tubes may not only increase the amount of ejected gas, but also increase the number of the corresponding nozzles 310, thereby further improving the ejection coefficient and reducing the generation of nitrogen oxides. Experiments show that by applying the flow channel design of the present application, the nitrogen oxide emission may be reduced from 80ppm (number of particles per cubic centimeter) to 20ppm.

[0039] Further, the flame distributor 100 further includes a pitch positioning structure 150 provided outside the ejection tube 110, each pitch positioning structure 150 includes a first protrusion 151 and a second protrusion 152 symmetrically provided, where the first protrusion 151 is formed by protruding the first housing 100A towards the outside of the ejection tube 110, and the second protrusion 152 is formed by protruding the second housing 100B towards the outside of the ejection tube 110.

[0040] As shown in FIG. 3, the distance between the first protrusion 151 and the second protrusion 152 is D5, and the outer diameter of the inlet end 113 of the ejection tube 110 is D4, where D4 is equal to D5, so that the side walls of the inlet ends 113 of the two adjacent flame distributors 103 and 104 may abut to each other, and the pitch positioning structure 150 of the two adjacent flame distributors 103 and 104 may abut to each other, that is, the first protrusion 151 of the flame distributor 103 abuts against the second protrusion 152 of the flame distributor 104.

[0041] It should be noted that in the present embodiment, the number of pitch positioning structures 150 are not limited, for example, one pitch positioning structure 150 may be provided outside one of the ejection tubes 110, or one pitch positioning structure 150 may be provided outside each ejection tube 110. It is feasible as long as the side walls of the inlet ends of the two adjacent flame distributors 100 may abut to each other, and the pitch positioning structures 150 of the two adjacent flame distributors may abut to each other.

[0042] In the present embodiment, the pitch positioning structure 150 may make the fixation between a plurality of flame distributors 100 more firmly, and reduce shaking or vibration, thereby reducing noise generated by the combustor 10 during operation.

[0043] Further, as shown in FIG. 4 and FIG. 5, a plurality of flame distributors 100 include a first flame distributor 101 and a second flame distributor 102 arranged at the end of the combustor 10, the combustor 10 further includes a first pressing plate 171, a second pressing plate 172, a connecting piece 180, a first fastener 191 and a second fastener 192. The first pressing plate 171 is positioned on the outer side of the first flame distributor 101, and the second pressing plate 172 is positioned on the outer side of the second flame distributor 102; the connecting piece 180 passes through the first pressing plate 171, respective flame distributors 100 and the second pressing plate 172, sequentially; further, the connecting piece 180 is fixedly connected to the first pressing plate 171 through the first fastener 191, and the connecting piece 180 is fixedly connected to the second pressing plate 172 through the second fastener 192, so that the first pressing plate 171 and the second pressing plate 172 press each flame distributor 100 from both ends of the combustor 10 tightly. Preferably, in the present embodiment, the connecting piece 180 may be a double-thread screw, while the first fastener 191 and the second fastener 192 may be bolts.

[0044] As another aspect of embodiments of the present invention, in the present embodiment, it is also provided a flue gas water heater including the combustor according to above embodiments. Other configurations of the gas water heater of the present embodiment may employ various technical schemes known to those ordinary skilled in the art now and in the future, and will not be described in detail herein. According to the flue gas water heater of the present embodiment, due to the adoption of the above-mentioned combustor 10, a sufficient amount of gas may still be ejected without a fan, so that the ejection coefficient is improved, and the generation of nitrogen oxides is reduced.

[0045] As another aspect of embodiments of the present invention, in the present embodiment, it is also provided a wall-mounted furnace including a combustor according to above-described embodiments. Other configurations of the wall-mounted furnace of the present embodiment may employ various technical schemes known to those ordinary skilled in the art now and in the future, and will not be described in detail herein.

[0046] The above-mentioned content only refers to preferred embodiments of the present invention, which should not be regarded as limiting the protection scope of the present invention, within the technical scope disclosed by the present invention, it is readily envisaged by any skilled in the art that various modifications and variations can be made, and such modifications and variations are considered to be within the scope of the present application. Therefore, the protection scope of the present invention should be subject to the protection scope of the claims.

Claims

1. A combustor, **characterized by** comprising a plurality of flame distributors, the plurality of flame distributors are distributed side by side along a width direction, the flame distributor comprises at least three ejection tubes, the ejection tube is provided with an ejection section and a gas outlet section in a sequence according to a gas flow direction, and the ejection tube comprises:

   a throat, being provided at a minimum cross-section of the ejection section, wherein a length of the ejection section is H1, and a maximum width of the throat allowing gas to pass through is D1, wherein $8.5D1 \leq H1 \leq 9.5D1$; and
   a diverter, being provided in the gas outlet section, having an apex corner for diverting gas towards two sides, an angle of the apex corner being 45 degrees to 85 degrees.

2. The combustor according to claim 1, **characterized in that** the ejection section comprises:

a premixing section, the ejection tube has a uniform cross-sectional shape in the premixing section, a length of the premixing section is H11, wherein $2D1 \leq H11 \leq 3D1$; and
a diffusion section, gradually deviating from a central axis of the ejection tube along a gas flow direction, a length of the diffusion section is H12, wherein $3.5D1 \leq H12 \leq 4.5D1$.

3. The combustor according to claim 1, **characterized in that** the ejection section has an inlet end and an outlet end, a maximum width of the inlet end being greater than or equal to a maximum width of the outlet end, and the maximum width of the inlet end being greater than or equal to 18mm.

4. The combustor according to claim 3, **characterized in that** the inlet end has an arc-shaped cross-section, the arc-shaped cross-section being formed by recessing a center of the inlet end towards the outlet end.

5. The combustor according to claim 1, **characterized in that** $11mm \leq D1 \leq 14mm$.

6. The combustor according to claim 1, **characterized in that** a length of the gas outlet section is less than or equal to 30%H1.

7. The combustor according to claim 1, **characterized in that** the combustor further comprises a gas distribution device , the gas distribution device provided below each of the ejection tube, a plurality of gas passages being provided in the gas distribution device , the gas distribution device further comprising a plurality of nozzles , the gas distribution device being communicated with the ejection tubesthrough the nozzles , the nozzle having a diameter D0, wherein D1=2D0.

8. The combustor according to any one of claims 1 to 7, **characterized in that** the flame distributor comprises a first housing and a second housing, the fist housing and the second housing are symmetrically arranged, a gas channel of the ejection tube being formed by an enclosure of the first housing and the second housing; the diverter comprises a first recess and a second recess , the first recess and the second recess are symmetrically arranged, the first recess being formed by recessing the first housing into a cavity of the ejection tube, the second recess being formed by recessing the second housing into a cavity of the ejection tube, a gas channel being provided between the first recess and the second recess; the flame distributor further comprises a top plate covering a top of the ejection tube, the top plate being provided with a plurality of fire holes; and the first housing is snap-fitted with the second housing, and the top plate is snap-fitted with the first housing and with the second housing.

9. The combustor according to any one of claims 1 to 7, **characterized in that** the diverter further comprises at least two through holes, the through hole being provided between two adjacent ejection tubes, the through hole is configure to allow a cooling water pipe to pass through and being in close contact with the cooling water pipe.

10. A water heater, **characterized by** comprising a combustor according to any one of claims 1 to 9.

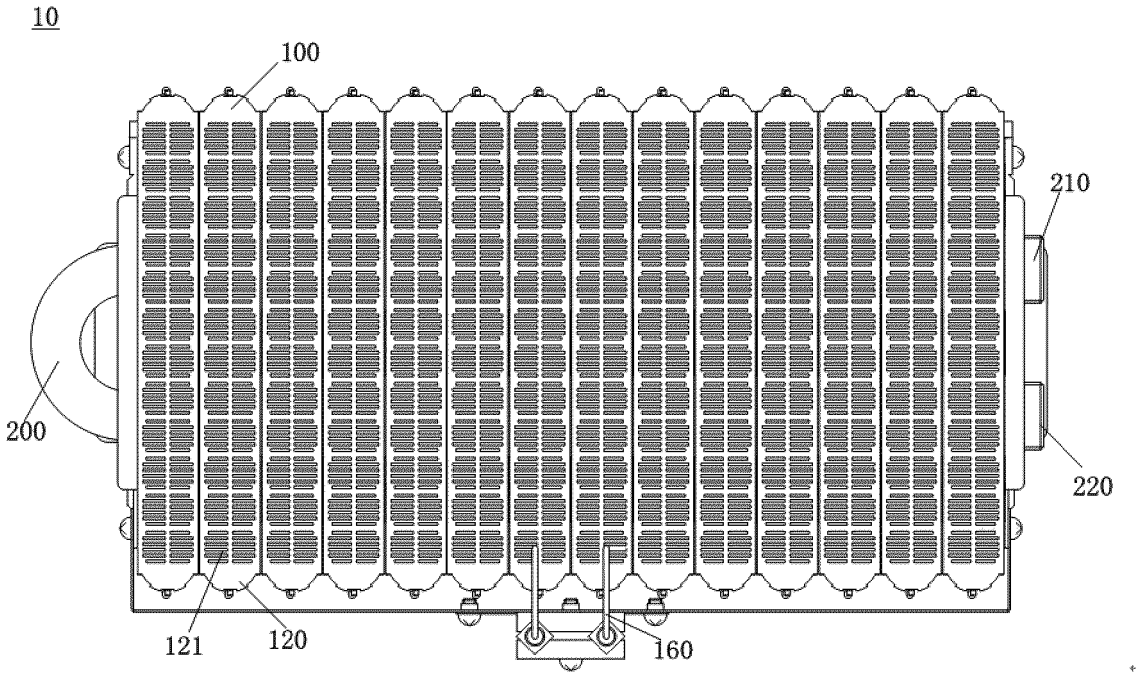
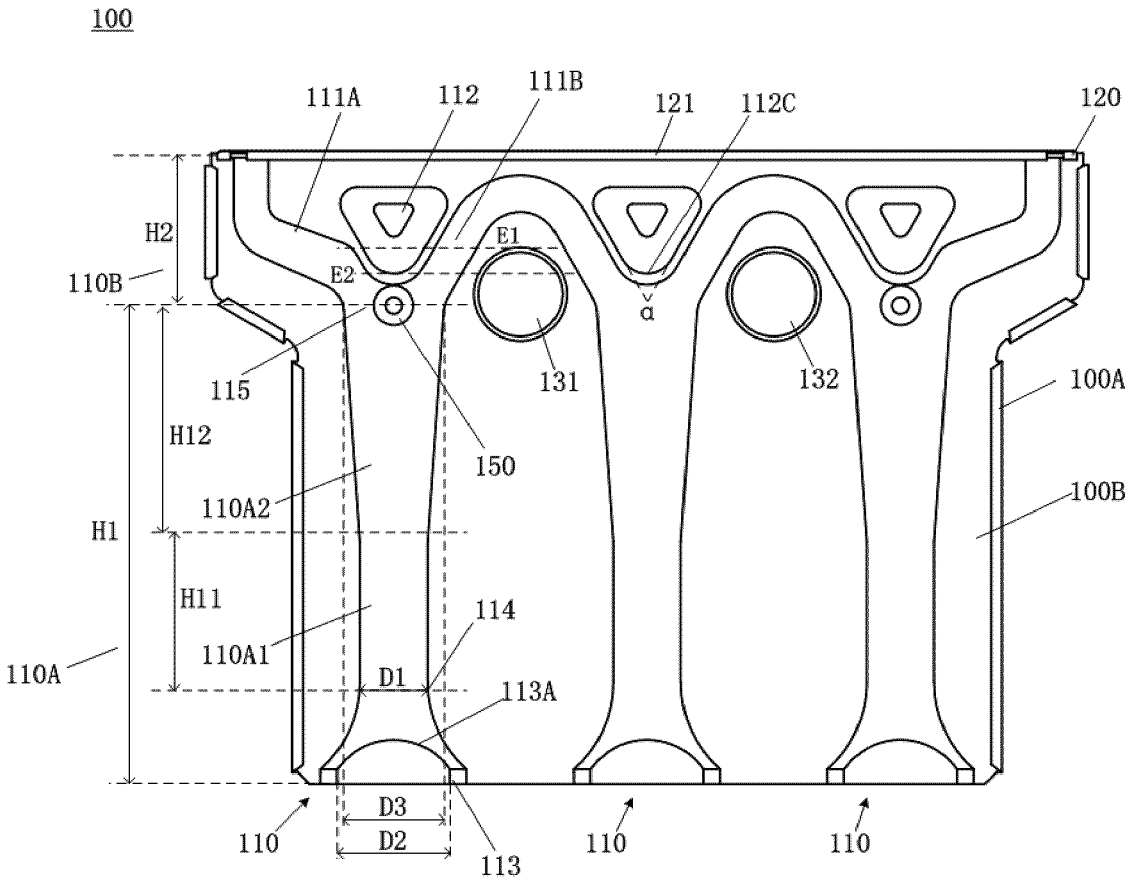


FIG. 1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111A
112
111B
121
112C
120
H2
110B
E1
E2
a
115
131
132
100A
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H12
100B
110A2
H1
H11
114
110A1
110A
D1
113A
D3
D2
110
110
110
113

FIG. 2

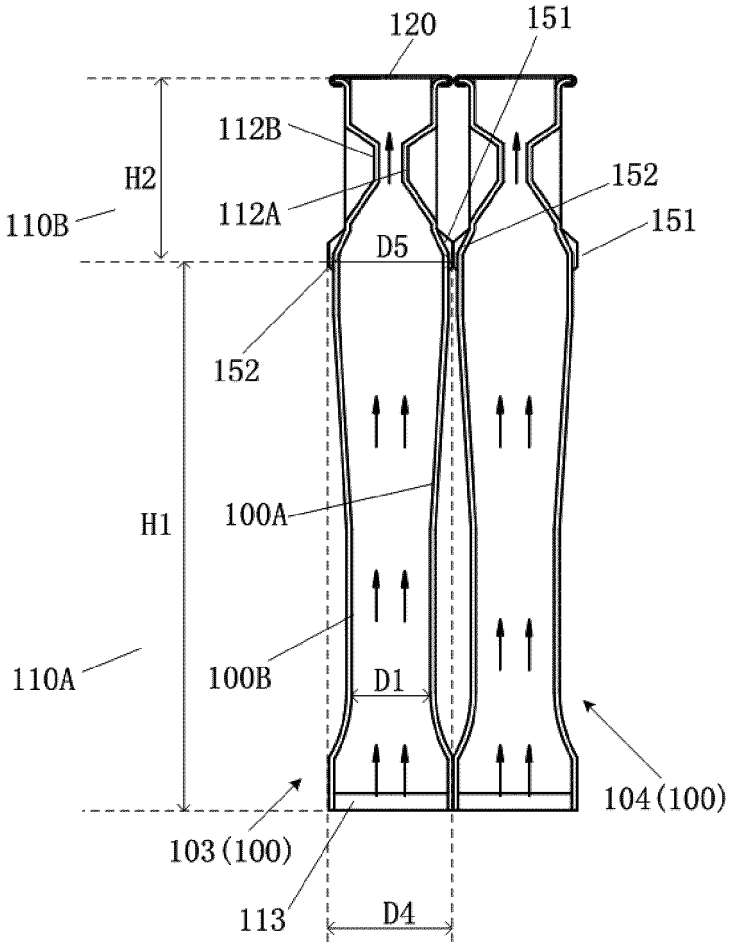
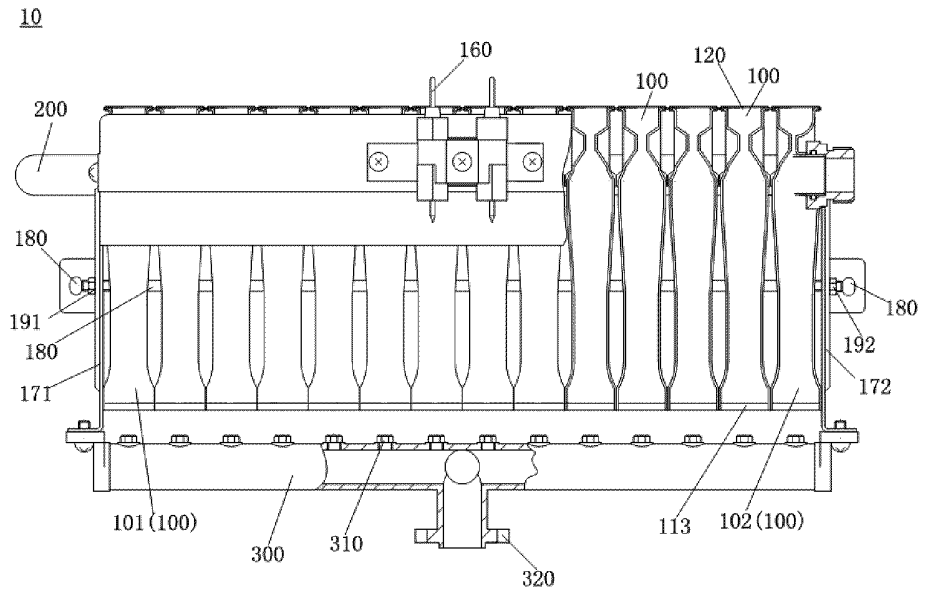

120
151
112B
H2
110B
112A
152
151
D5
152
H1
100A
110A
100B
D1
104(100)
103(100)
113
D4

FIG. 3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160
120
100
100
200
180
191
180
171
180
192
172
101(100)
300
310
320
113
102(100)

FIG. 4

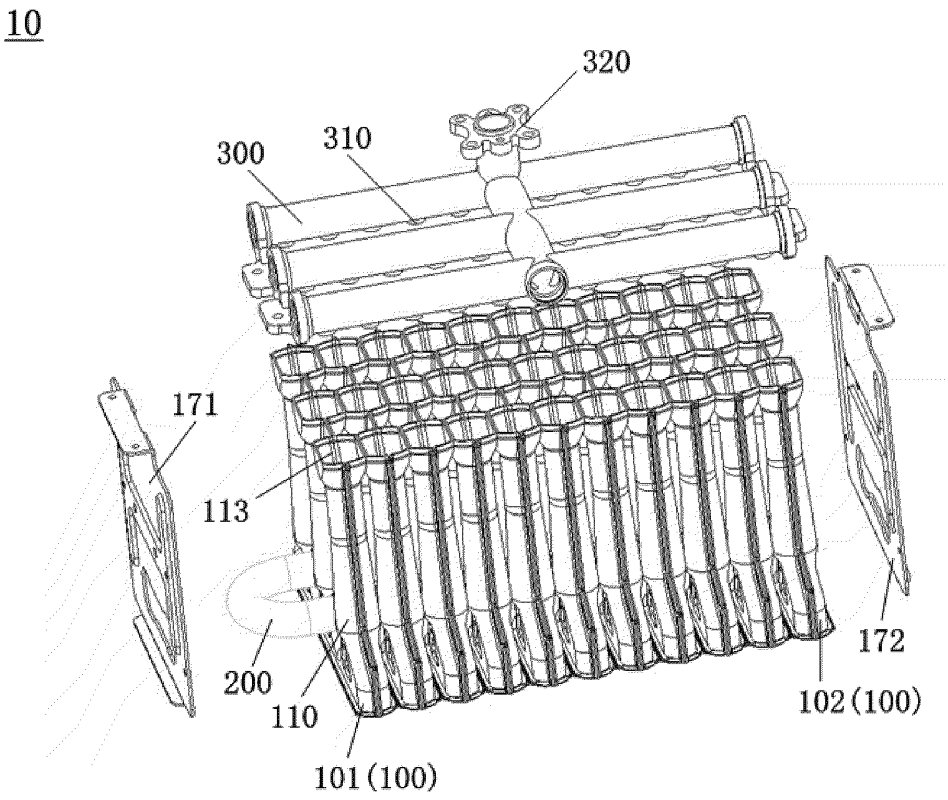
10
320
300
310
171
113
200
110
101(100)
172
102(100)

FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2018/091102

A. CLASSIFICATION OF SUBJECT MATTER

F23D 14/08(2006.01)i; F23D 14/46(2006.01)i; F23D 14/84(2006.01)i; F23D 14/64(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F23D 14

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNABS, CNTXT, CNKI, VEN: 燃烧器, 分火器, 引射, 直径, 长度, 引射系数, 能量损失, burner, combustor, inject+, diameter, length, coefficient, energy, loss

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
E	CN 208205002 U (WH MEDIA KITCHEN & BATH APPLIANCES MFG CO., LTD. ET AL.) 07 December 2018 (2018-12-07) claims 1-10, description, paragraphs [0048]-[0068], and figures 1-6	1-10
A	CN 203784951 U (WENCHENG DAOFENG TECHNOLOGY CO., LTD.) 20 August 2014 (2014-08-20) description, paragraphs [0014]-[0018], and figures 1-2	1-10
A	CN 103591581 A (WISDRI (WUHAN) WIS INDUSTRIAL FURNACE CO., LTD.) 19 February 2014 (2014-02-19) entire document	1-10
A	KR 20150002484 U (LEE S.J.) 25 June 2015 (2015-06-25) entire document	1-10
A	TW I621813 B (GRAND MATE CO., LTD.) 21 April 2018 (2018-04-21) entire document	1-10

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 January 2019	**12 February 2019**

Name and mailing address of the ISA/CN	Authorized officer
State Intellectual Property Office of the P. R. China **No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088** **China**	
Facsimile No. **(86-10)62019451**	Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2018/091102

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 208205002 U	07 December 2018	CN 108548178 A	18 September 2018
CN 203784951 U	20 August 2014	None	
CN 103591581 A	19 February 2014	CN 103591581 B	18 November 2015
KR 20150002484 U	25 June 2015	None	
TW I621813 B	21 April 2018	None	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 201810462349 **[0001]**